Research Data Repositories in Perspective of Climate Change: India to lead The World in Big Data Analytics with G-20 Summit

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Abstract

Background:Climate change is one of the major environmental challenges that have been faced by every nation. Data is the key factor for any nation for its progress. Different data repositories are maintain by different disciplines, organizations or nations. Technology is a boon for dealing with different global problems. Data science if merge with technology can bring a major development in our society. The G20 in its 2023 vision has clearly mentioned about "One Earth One Family One Future" which further expressed its concern towards the global problem related to climate change faced by the nations. The G-20 presidency of India may bring a common platform for countries to store and exchange their data with one policy and technology.

Objectives:The study targets to identify different data repositories available in the world on the domain of climate change. The study also targets the data repositories of India. The study refers to identify the strength of G-20 countries on climate change domain data repositories with a proposal for creating a Unified global data repository on the domain.

Methods:The method for the study is based on the available data repositories under the Registry of Research data repositories related to climate change. The climate change repositories were identified by following four areas of universe of knowledge.

Results:The study found that there are 217 repositories of the 22 nations or unions on climate change domain. Further, the study also found that there are 62 data repositories identified which are created after the cooperation among nations or union. India individually is found to have 11 numbers of data repositories on the domain.

Implications:The findings of the study can be applied for mitigating the global challenge faced by the world in terms of climate change by implementing the domain of data science. The study may lead India to serve as a Global leader in mitigating the global problem of climate change through its G-20 Presidency.

Keywords: Climate Change, Data Repositories, G20, Research Data Repositories

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1. Data analytics in Mitigating Climate change

Today, Data and Information are the primary needs of any knowledge society. A country's decision-making capability can be fully improvised by the processing of ground-level data. Different institutions or disciplines are creating or maintaining different information repositories or data repositories to support their missions and visions.

Climate change is one of the major environmental challenges that is faced by every nation. Every nation has its own data privacy rules and regulations. Climate issues are today not a local scenario but a global concern. It is a global challenge that needs to be seriously dealt with the cooperation of all the countries of the world. It has adversely affected food production, human health, weather, flora and fauna, the ecosystem in the high mountain areas, the water conservation system, etc. World Health Organization (2021) in the report on Climate Change has mentioned that taking the help of technology "Integrated monitoring systems allowing collection and analysis of data on environmental hazards, socio-economic factors and health outcomes are established"(WHO, 2021). Parth and others (2019) in a study have concluded that the power of information can mitigate the effects of climate change. In their study, they have mentioned that lack of micro-level data has adversely impacted climate change related to agriculture. The study has also recommended a policy for providing access to agricultural data to farmers using ICT tools (Parth et al., 2019).

2. Objective of the Study

The following are the main objectives of the study:

- ❖ To know the status of different climate change related data repositories available across the world.

- ❖ To explore the status of Indian data repositories related to climate change.

- ❖ To propose and prepare a roadmap for global unified data repositories with the G20 presidency of India

3. Methods

The method for the study is based on the available data repositories registered in the Registry of Research Data Repositories (re3data.org) related to climate issues. Both browsing and searching technique were applied to collect the data. Climate change repositories were identified considering the issue of climate change from four broad areas- Lithosphere, Atmosphere, Hydrosphere and Biosphere. Further, the repositories are finally considered after properly verifying the content area and the important keywords entered for each of the repositories. The study has followed four methods for collecting data:

- ❖ Data Repositories of Individual countries search with the keyword "Climate" which is followed by content analysis of the repository. The collected data is used in the Table:1 of the study.

- ❖ Data Repositories of Cooperative countries search with the keyword "Climate" which is followed by content analysis of the repository. The collected data is used in the Table:2 of the study.

❖ All the data repositories of India are available on the registry on climate change which is followed by content analysis of the repository (browsing and examining the subject content of each of the repositories). The collected data is used in Table 3 of the study.

❖ Browsing the data repositories of the five G-20 countries whose repositories are not discoverable (as individual registered countries) while searching through the keyword search word "Climate" (related to the concept of climate change as per the study). The collected data is used in Table 4 of the study.

4. Limitations of the study

For collecting the global data for the available climate change repository, the search is limited within the website of the Registry of Research data repository. Further, the word "International" used by the Registry of Research data repository to represent the international countries without any particular nomenclature of the nation is also used in the study for representing the name of a country/region.

5. Data repository in perspective of climate change

5.1 Global Scenario

As per the data extracted from the Registry of Research Data Repositories, there are 3148 data repositories which are registered in the registry (as of 27/08/2023). Using the search access term "climate", 307 data repositories were found to be in the displayed result. Further, all the 51 repositories available for India were searched separately. Out of the 358 repositories examined individually, the repositories that are either no longer in existence or do not have any content related to climate change issue were not considered for this study. After browsing and exploring each of the 358 repositories, 279 repositories were considered to highlight the global scenario of the countries in maintaining the data repositories related to climate change.

Table 1: Status of data repositories of different individual countries and regions in the Climate Change domain.

Sl. No	Name of the Country/Region	Number of Repositories identified
1.	United States	96
2.	Germany	27
3.	Canada	25
4.	Australia	12
5.	United Kingdom	11
6.	*India	11
7.	France	8
8.	Netherland	4

9.	European Union	4
10.	Japan	3
11.	*International	3
12.	Norway	2
13.	South Africa	2
14.	Sweden	2
15.	Austria	1
16.	China	1
17.	Finland	1
18.	Italy	1
19.	Luxembourg	1
20.	Spain	1
21.	Switzerland	1

*International: The word international was used in Registry of Research Data Repositories without identification of any nomenclature of any particular country.

*India: The data for India is collected by browsing all the 51 repositories available for India in Registry of Research Data Repositories

From, the above Table 1, it is found that 217 data repositories are registered by the institutions, organizations or the discipline of twenty-one countries and unions related to environment and climate change discipline. The United States is found to have the highest number of data repositories registered related to the subject content of the climate change domain. The Table:1 also reflects that Germany (27) and Canada (25) have approximately equally registered data repositories. Similarly, Australia (12), the United Kingdom (11) and India (11) also have approximately equally registered data repositories. France is found to have registered eight numbers of data repositories. The Netherlands and the European Union have registered four data repositories. Japan and International have registered four repositories. South Africa and Sweden have registered two each. Further, there are seven countries (viz. Austria, China, Finland, Italy, Luxembourg, Spain, Switzerland) whose one data repository respectively are registered in the Registry of Research Data Repositories related to the domain of climate change.

Table2: Status of different data repositories on climate change domain created with the cooperation and leadership among the countries and region.

Sl. No	Name of the Country/Region	Number of Repositories considered
1	*European Union / Others	18
2	*United States / Others	11
3	*International / Others	10

4	*Germany and others	4
5	*France and others	4
6	*Australia and others	2
7	Canada /United States	2
8	International / Germany	2
9	China / International	1
10	Italy / International	1
11	Indonesia / Netherland	1
12	Spain / Germany	1
13	Switzerland / International	1
14	Belgium /Germany / United Kingdom/ France	1
15	Burkina Faso /Germany /Ghana	1
16	Russia Federation / Japan	1
17	Cyprus / European Union	1

International: The word international is used in the Registry of Research Data Repositories without identification of any nomenclature of any particular country.

Here details of the cooperative countries are provided as mentioned in Table:2.

*European Union (EU) / Others -EU and International=2
-EU / International/Italy=1
-EU /International/Finland/Norway=1
-EU/International/Belgium/US/Germany/Switzerland=1
-EU /International/Belgium/US=1
-EU/International/France/US/Finland=1
-EU/ Norway=1
-EU/Austria/Norway=1
-EU/Germany=2
-EU/Germany/Belgium=1
-EU/Iceland/Germany/Switzerland/Italy/International=1
-EU/Slovenia=1
-EU/Sweden/Netherland=1
-EU/Netherland=1
-EU/Sween/Germany/Netherland/France/Switzerland/United Kingdom=1
-EU/France/Russia Federation/Italy/Greece/UK/Netherland/Germany=1

*United States (US) / Others
-US/United Kingdom=1

-US/Norway=1

-US/Brazil/Australia/Netherland/India/International=1

-US/Brazil=1

-US/France=1

-US/France/International/European Union=1

-US/France/Japan=1

-US/Mexico=1

-US/Switzerland/Germany=1

-US/Germany/ European Union /Brazil/Japan/China/Korea/Australia/India=1

-US/ International=1

*International / Others

-International –Australia=1

-International -United States=2

-International - United States/Canada=1

-International-Canada=2

-International-France =2

-International-Kenya=1

-International-New Caledonia-Fiji-France-1

*Germany and Others

- Germany / United States / International=1

- Germany / International=3

*France and Others

- France / Sweden=1

- France / Unites States=1

France / India=1

France / Cameroon / India / Lao's People /Democratic Republic/ Viet Nam=1

*Australia and others

- Australia / United States=1

Australia / United Kingdom=2

The above Table 2 reflects the status of different data repositories which are created with the cooperation and leadership among the countries or with the Union. From, the above Table 2, it is found that there are 62 data repositories identified which are registered with the help of cooperation of the institutions, organizations or the disciplines of the different countries and union of the world related to climate change domain. It is also found that the European Union, United States, International, Germany and France provide the leadership to different countries of the world for creating different data repositories related to environment and climate change. Further, it is also found that Australia, Canada, the Netherland, Switzerland, and Belgium are also contributing to data repositories by participating or cooperating with the different nations in the different data repositories available in the Registry of Research Data Repositories related to the domain of climate change.

5.2 Indian Scenario of Data Repository from the Perspective of Climate Change

Different countries maintain different data repositories to collect, analyze, visualize and store the data related to climate change. In India, the National Information System for Climate and Environment Studies (NICES) maintains the national-level climate database (Information for Climate and Environmental Changes, n.d.). Similarly, the National Remote Sensing Centre (NRSC) is maintaining the satellite data (NRSC, n.d). Meteorological and Oceanographic Satellite Data Archival Centre (MOSDAC)-a data center of Space Application Centre maintains the satellite data with regard from its collection to data visualization and dissemination (Meteorological & Oceanographic Satellite Data Archival Centre, n.d.). India- Water Resource Information System (WRIS) is the repository for maintaining data on water resources and allied themes (India-WRIS, n.d.). Environment Monitoring and Research Center of the Indian Meteorological Department (IMD) monitors ozone monitoring, precipitation chemistry, aerosol monitoring, black carbon monitoring, air quality forecasting and research (SAFAR) having different network stations within the country (India Meteorological Department, n.d.). Further, to mitigate climate change issues, IMD is contributing its data and information to the World Meteorological Organization. The India Environment Portal maintained by the Centre for Science and Environment (CSE) has built its repository using the open-source software Drupal. This repository maintains the environment related data such as water and air pollution; forest, land and agriculture, atmospheric data; energy, biodiversity, etc. (India Environment Portal, n.d.). India's ENVIS (Environmental Information System) programme maintains another data repository related to environmental science (Environmental Information System, n.d.). India is also a participating nation for the data repository of the World Agroforestry Centre - ICRAF Dataverse (World Agro Forestry, n.d.). Further, there are many other data repositories maintained by different organizations and institutes in India that cater to the need of their users.

Table 3: Status of different data repositories created or participated in by India relating to Climate Change (as search in Registry of research data repositories)

Sl. No	Name of the Repository	Last Updated	Access to Data Repository	As Individual country/ Cooperation with others
1.	India Environment Portal	2021-11-16	Open	Individual
2.	India Water Portal	2021-12-22	Open	Individual
3.	Open Government Data Portal of Tamil Nadu	2023-02-14	Open	Individual
4.	KRISHI	2022-03-24	Open	Individual
5.	National Data Repository	2019-05-15	Open	Individual
6.	NER Databank	2019-11-18	Open	Individual
7.	Biosearch	2021-08-25	Open	Individual

8.	India Biodiversity Portal	2021-11-16	Open	Individual
9.	World Data Centre for Geomagnetism, Mumbai	2018-12-19	Open	Individual
10.	Indian National Centre for Ocean Information Services	2023-05-26	restricted	Individual
11.	Indian Space Science Data Center	2021-10-06	restricted	Individual
12.	TropFlux	2022-02-07	Open	Cooperation
13.	M-TROPICS	2023-06-02	Open	Cooperation
14.	WorldClim	2022-01-18	Open	Cooperation
15.	International Ocean Discovery Program	2022-12-20	Open	Cooperation

The above Table 2 reflects the s

Table 3 indicates that out of the 51 repositories registered for India, there are eleven data repositories registered for India in the Registry of Research Data Repositories registry, which provide data on the domain of climate change. Further, the Table 3 also reflects that India is a participating nation for the four numbers of data repositories (i.e., two repositories each led by the United States and France).

6. G-20 and Presidency of India for Unified Global Data Repository- A Proposed Roadmap

National Interagency Fire Center open data site of the United States has tremendously helped the public by open access usage of the data sets dealing with wildfire (*Wildfire Open Data Is Driving Innovation and Improving Public Safety*, 2021). The open access availability of data has helped to mitigate a dangerous problem related to human safety. So, data sharing policy can bring a constructive development if used with proper ethics.

On June 30, 2008, India launched its National Action Plan on Climate Change where it has launched eight different missions on climate areas. Also, the year 2023 is of great importance for India as it is holding the G20 presidency (*Government of India, Ministry of External Affairs*, n.d). The G20 in its 2023 vision has mentioned "One Earth One Family One Future" which further expressed its concern towards the global problem related to climate change faced by the nations.

Table 4: Status of G-20 members participating in Registry of Research Data Repositories repository related to climate change

Sr.No	G-20 Members data repository related to issue of climate change in Registry of Research Data Repositories	Status of Repository in Registry of Research Data Repositories on climate change as Leading Nation
1.	Argentina	*Yes
2.	Australia	Yes
3.	Brazil	*Yes
4.	Canada	Yes

5.	China	Yes
6.	France	Yes
7.	Germany	Yes
8.	India	Yes
9.	Indonesia	#Yes
10.	Italy	Yes
11.	Japan	Yes
12.	Mexico	*Yes
13.	Republic of Korea	*Yes
14.	Russia	*Yes
15.	South Africa	Yes
16.	United Kingdom	Yes
17.	United States of America	Yes
18.	European Union	Yes
19.	Turkiye	No
20.	Saudi Arabia	No

* In Registry of Research Data Repositories, browsing of the repositories was done individual country wise on climate change.

Repository maintains with cooperation among countries

From the above Table 4 it is found that except two countries (i.e. 10 per cent), 90 per cent of the G-20 members are having registered repositories in Registry of Research Data Repositories either individually or with the cooperation of different countries related to domain of climate change. This indicates that G-20 member countries are playing a leading role in maintaining different types of data related to the climate change domain.

6.1. Proposed Roadmap

With the support of G-20 members, a global unified data repository related to climate change is proposed. Following are the proposed steps for the unified data repository.

1. India may propose a model with its G-20 presidency for a global unified data repository with the participation and contribution of all the G-20 member countries.

2. Based on the different subject coverage of climate change, the proposed repository may cover all the aspects of the sphere i.e. Lithosphere, Atmosphere, Hydrosphere and Biosphere so that different areas of climate change will be reflected.

3. It is proposed that a common policy on data submission, its use and budgetary provisions may be proposed by India for all the G-20 member countries

4. Ministry of Environment, Forest and Climate Change, Government of India may be proposed to initiate all the general and technical works from India with cooperation from data or information management systems/centres available in India. Further, the experiences of the G-20 members who have a rich history and experience in managing the data repository can also be utilized. According to the data access from Registry of Research Data Repositories, the United States (1172), Germany (504), Canada (394), United Kingdom (321), France (128) Australia (103) have the highest number of data repositories covering different universe of knowledge as per the registry. It is also proposed that at the initial level, all these G-20 members may assist in framing the policies, technical infrastructure, etc.

5. It is also proposed that all the G-20 members may be requested to update their data repository before the start of the G-20 summit every year.

6. Further, the study proposes for equal storage of data to be stored in all the G-20 member countries.

7. It is also proposed that every year the country or region that will hold the G-20 presidency may lead the global unified data repository on climate change. This may involve the cooperation of the nations.

2. Findings

1. It is found that out of the 279 data repositories identified, 217 repositories are registered in the category of an individual country (Table 1).

2. It is also found that there are 62 data repositories identified (related to climate change) which were created or contributed with the cooperation of different nations or unions. (Table 2).

3. The study found there are 11 individual data repositories registered for India in the Registry of Research Data Repositories related to domain of climate change (Table 3). In addition to it, there are different data repositories (related to the data dealing with climate change) maintained by different organizations/ institutions from India which are yet to be registered in the Registry of Research data repository.

3. Suggestions

The study has suggested a proposed roadmap for creating a unified global data repository under the G-20 presidency of India.

4. Conclusion

Data is the backbone of any global, regional, state or micro-level system. To deal with global issues, international cooperation is the key parameter. The theme of World Environment Day of 2022, i.e. "Only One Earth" clearly demands that all the countries of the world need to be united while dealing with environmental issues. Data science can further relate to the theme of World Environment Day by demanding that the countries share their data related to climate change not individually but with collaboration. The individual nations may have to understand the importance of data related to issues of climate change. Any kind of global unified data repository can only be possible if the cooperation of the international countries is

acquired. The proposed roadmap for a unified global data repository on climate change with G-20 members may create an example for the entire world. It will give a direction not only to frame policies on these issues but also adopt the technological advancement for managing the data sets.

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